OPERATIONAL CHARACTERISTICS OF THE MANAGEMENT OF PRODUCTION SYSTEMS

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Abstract*: This article presents the main characteristics of quality of big systems, particularly the production systems. There are analyzed in detail dynamics of the qualitative manifestation, qualified reply, timely adjustment and reliability.*

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1. DEFINING THE OPERATION OF BIG (COMPLEX) SYSTEMS

Operation is usually **the fundamental measure of quality,** in case of the big systems, social and computer sciences systems generally, and for the technological ones in particular.

By operation we understand:

- **Qualitative manifestation** (expected, foreseen by parameters) of the system in system structuring time (operational, functional, technological, existential);
- **Qualified reply** (qualitative and operational) of the system to the input variations (controlled, generated), to the pre-calculated environment disturbances as well as to the malfunctions possible to be tolerated or treated timely;
- **Timely adjustment** (optimum, expert type) to the pre-calculated finality changes, environment, structure and relations;
- **Reliability**, operative maintenance and controlled dynamics.

The operation may be appreciated, from the viewpoint of functioning in designed qualitative and safety parameters, as **system structuring time performance** (quality) of the risk management.

2. DYNAMICS OF THE QUALITATIVE MANIFESTATION

The production systems are, ordinarily, complex systems, hence, big systems both by extension (enterprises, technological lines etc.) and by functional density (procurement, technology, testing, sorting, warehousing, delivery etc.). Therefore, their qualitative manifestations are a fundamental trait of the operation and the conditions under which they must obey the requirements of ranking, flexibility and handling imposed.

A production system manifests are parametric dynamics (qualitative) by means of the parameters below.

- **Dynamics** represents the transformations within the system, so that to be able to face the changes imposed by the development policies, the dynamic manifestations of the events and by the time of restoring the systems (processes); the dynamics is given by the operational time.
- **Opening** represents the property of interacting between the production system and the environment where it is integrated. In case of an optimum open system, the number of inputs and outputs must be higher or at least equal with the number of orders and of reactions of the systems where they were integrated; in other words, there must be at least one input for the systems commands and for the reactions at least one output.
- **Complexity** – an intrinsic property of the systems, generally and hence, of the production systems in particular, refers both to the structuring (the multitude of components

and reactions between them) and to the functional density, including:

- The multitude of subsystems acting to provide functionality;
- The multitude of subsystems for analysis, provision, adjustment, opening, perfecting (self-learning);
- The multitude of subsystems for direct action (regulations, remedies);
- The multitude of functional relations between these subsystems;
- The multitude of exchange relations (of integration) between the production systems and the environment where they operate.

- **Self-regulation** – the capacity of a system to react to internal or external disturbances – is specific to cybernetic systems which have at least one regulating loop, acting to highlight some deviations (errors) from the defined (standard) state of normality. The production systems are complex cybernetic systems, with multiple regulating loops. The interruption times, the non rhythmic procurement, the technological errors, the operating mistakes, the deviations from the parameters established by the specification books, the deviations from the execution times of the operations or of the delivery etc. are defined as self-regulating parameters conditioning the operation of the production systems.

- **Informational – decision making character** is property belonging only to the self-regulating systems; the information represent the basic element of any management process and the decision making process is the sequence of at least three procedures:

- Decision – the option for a certain version of action;
- Action – the method of putting into practice of the decision;
- The effect (consequence) – the result of the action upon the system as consequence of the decision.

The production systems having a deep informational-decision making character are based on multiple elements of self-regulation:

- Multiple pieces of information, standards, norms, parameters, deviations, errors, actions;
- Procedures of processing information and of grounding decisions;
- Expert type decisions, dedicated to functional, technological, procedure and operation events;
- Procedures of preventing and treating the undesired events of mitigation of their procedure consequences;
- Post-event analyses;
- Expert procedures and perfecting self-isomorphic or isomorphic policies;

Antientropic character is the property of cybernetic systems of perfecting the management and of reducing the degree of internal disorganizing. In case of the production systems, the antientropic character is a structural and functional basic property, because their operation depends in a major manner by their governance all along their service duration for which they were designed to operate. The parameter of operation which characterizes in an antientropic manner the production systems is represented by the opportunity and effectiveness of the self-regulations, so of their capacity of maintaining the functionality of the parameters established by the self-governing, self-control and regulation.

3. QUALIFIED REPLY

The systems and processes management systems demonstrate that the timely reply (to stimuli) is not enough for their quality governing and it must fulfill also the condition of qualification of the reply. By a qualified reply we understand an action or a variation of a parameter which highlights a normal, functional behavior of the system, so that to keep the pre-established dynamics (the dynamics stability).

The qualified reply of the production systems is evaluated by the following properties:

- **Accessibility**, which presumes the existence of a command of the kind and intensity established by design, dedicated to make possible the transition from a state to another, and, as consequence, the generation of the qualified reply to stimulus, so that to have the possibility to return to the normal (in

the initial state or in a new pre-calculated state).

- **Detection** – dual of accessibility, presuming obtaining a qualified reply in the same direction as for accessibility but with an intensity that may be detected.
- **Noticeability** – the property due to which one may deduct the sequence of states (or a part of these) by which the production system must pass, by modeling its evolution, both structural and in interconnection. A noticeable (as manifestation) production system allows both maintaining under normal operation, including during the period of controlled and of transitions, and also its perfecting and adjustment to a sequence of re-established input-output pairs. Because of the adjustment conditions to the established policies, the production systems, in order to have a high operation, need a large scale of noticeability (as range of parameters), for each pair input-output.
- **Controllability** – allows the generation of a state of the system for next moment to come; in case of the production systems controllability must be complete for the final objectives and partial for the intermediate objectives.
- **Sensitivity** – the property of the system to reply to various stimuli depending on both the value of the time and on the intensity they act; in case of the big systems, the sensitivity is a fundamental parameter of the operation, this being the factor of which depends both the generation of the qualified replies and the number and frequency of false replies (technological or operational errors, rejects, interruptions) essential parameter of quality. The duality time-intensity make difficult the exact reestablishing pf some limits of sensitivity and, therefore, it is needed that the production systems to be provided with possibilities and structures to control the sensitivity thresholds (starting from initial values) and to direct them, according to some skills during the operational maturation. The values of the thresholds of sensitivity must be thus established so that to avoid the technological errors and the rejects.
- **Stability** – if for the systems and the processes the stability represents only the property to return to a state of equilibrium having the same set of values of the state vector during a period of time, in case of the production systems this property is manifested by generating the same global qualified reply in a pre-established range of the dynamics of the inputs or of the disturbing factors; in other words, it represents keeping the global functional operating under the conditions of variations of pre-calculated stimuli.
- **Capacity of adjustment** – the property of the system to keep being operational under different conditions of variation the inputs and the disturbing factors; in case of the production systems the property is defined as capacity of operational adjustment, keeping the global qualified reply being needed in time and in intensity, as well as during their entire service life. The operational adjustment has also a dual aspect, given by the need of adjustment both of the own input variations and of the environment variations.

4. TIMELY ADJUSTMENT

Although a few aspects referring to the capacity of adjustment have already been presented when the dynamics of the qualitative manifestation and the qualified reply have been analyzed, the separate treatment of this issue is necessary, at least because of the following considerations:

- The adjustment is not easy, during the automatic regulation of the processes but it is optimum, expert type.
- Two periods of time of adjustment are distinguishable: **the period of implementing the production systems** and **the period of operational maturation** or of the replacement with another system; the production systems, unlike the other systems, do not allow their keeping in a state of operational degradation even if this state does not presume the decrease of the operation under the admitted limit.
- Adjustment must be both of time and depending of the nature and intensity of stimuli.
- Man-machine character of the production systems imposes, on the one hand an adjustment and perfecting the human

component, and on the other hand an anticipating behavior also (self-isomorphic and isomorphic), according to a refined policy of higher continuous operation (optimum, expert type).

The adjustment procedures are supervised by the operational management of the production system and are based on:

- Adjustment by regulating the output parameters and the states depending on the variation of inputs and of the disturbing factors;
- Adjustment by controlling the generation of the input magnitudes at the level of systems or processes;
- Self-regulation during the treatment of and malfunction events;
- Own optimum management (statistics, dynamics or on limit) or supervised by the environment where they are integrated;
- Functional, structural, informational-decision making, interaction, technological and operational perfecting as well as procedural, strategic, political perfecting and of objectives.

5. RELIABILITY, OPERATIVE, DYNAMIC AND CONTROLLED MAINTENANCE

Safety in operation (reliability) of the production systems represents their quality to achieve without interruption their fundamental functions under the conditions of pre-established environment and during a determined period of time (life duration of the system). Reliability represents, hence, the first condition of system operation, generally and of the production systems in particular.

Very complex, **the maintenance of the production systems** needs profound studies; therefore, two aspects will be considered:

- **Maintenance** must provide the production systems with an instant availability as close as possible to the optimum designed value (constant or continuously variable) and to never drop under the value imposed by the strategy of development.
- **Stationary availability** of the production systems must be higher than those of the environments where they are integrated.

The issue of the controlled dynamics is associated recently to the operation, this being considered at least until present, a simple matter of regulation or self –regulation.

The controlled dynamics, for the production systems is, first of all, a strategy of behavior, especially mixed, man-machine, and second ranks the political problem of adjustment, learning and perfecting.

The controlled dynamics is an active component of the operation of the production systems, targeting the following aspects:

- Risk-cost relationship and the operational procedures resulting from this multiple and complex relation.
- The action policy and sub optimum operation when the costs for optimum cannot be born.
- The appreciable rhythms of physical perishing and tear and wear of the production systems and the need to replace the strategy of the behavior and technology with the same rhythm.
- Existing of multiple loops or positive and negative regulations, related to the development policy.
- The need to achieve a double synergy of the system and of the environment where it is integrated.

Hence, the controlled dynamics targets time performances (regulating, choice of strategy, reaction, reply, perfecting, authorization, etc.) and intensity performance.

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